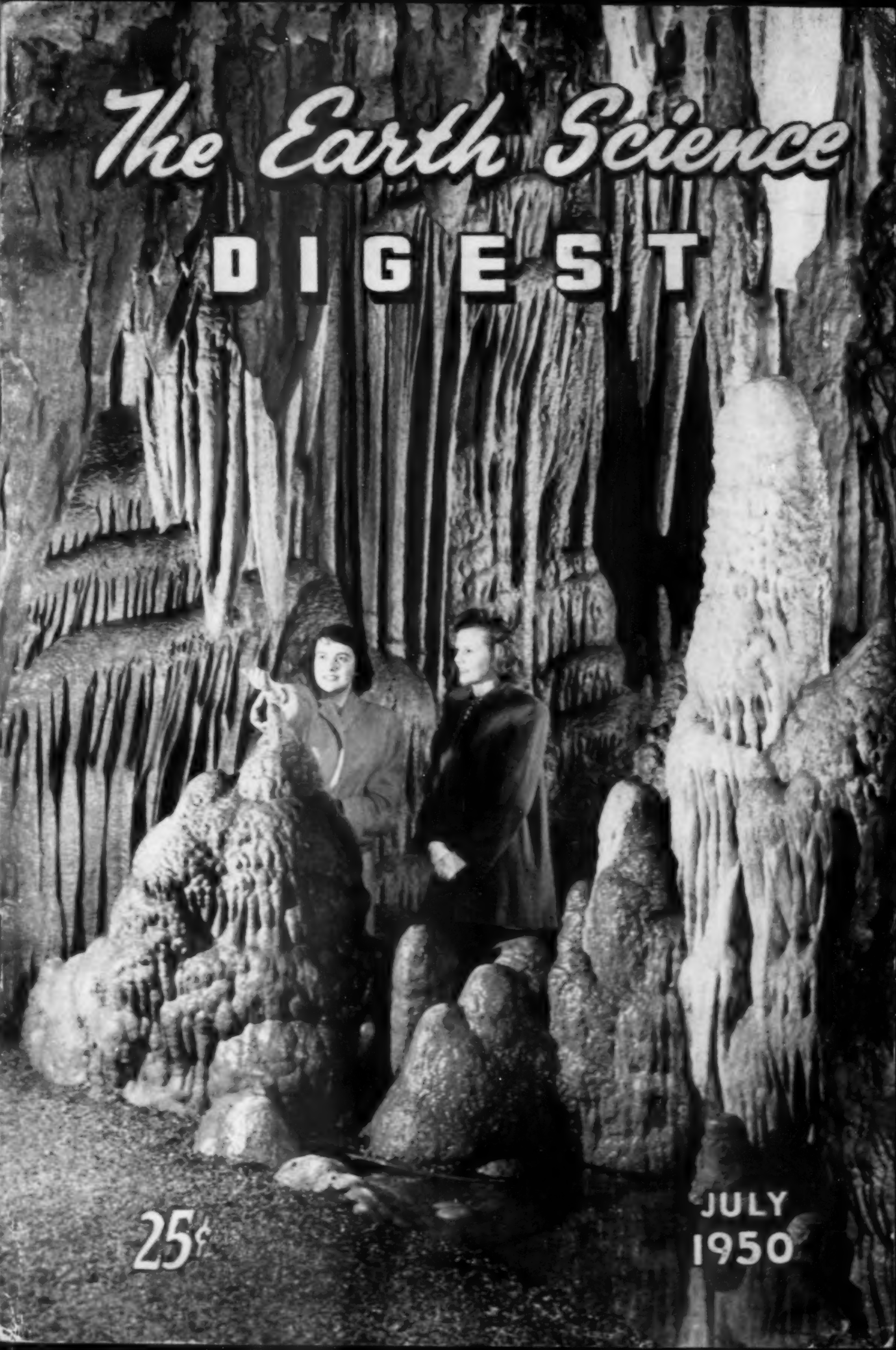
The Earth Science DIGEST



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EROSION STUDIES AT PARICUTIN, MEXICO, COMPLETED

WASHINGTON, July 9 — Studies showing how nature is already wearing away the slopes and the ejectamenta of Mexico's youthful volcano, Paricutin, have been completed by the U. S. Geological Survey.

Paricutin, the volcano that grew in a cornfield and eventually laid waste to much valuable timber and farmland as well as the town of San Juan Parangaricutiro, is about 190 miles west of Mexico City. It can be reached by air, rail, or paved highway to Uruapan, and thence by paved and dirt road to the lava-destroyed town. The site constitutes one of Mexico's most popular tourist attractions.

The report is an outgrowth of an invitation issued by the Mexican Government in 1943 inviting scientists of the United States to participate in basic research at this unusual outdoor "laboratory". Here scientists from all over the world have been able to study at first hand the mechanism whereby elements such as sulfur, metals, etc., are moved upward from the earth's interior. Ultimately most mineralization can be traced back to igneous action that gives rise to such geologic features as batholiths, dikes and sills. Areas of mineralization in the country rock are commonly associated with these kinds of volcanic and igneous activity.

Kenneth Segerstrom, Survey geologist and author of the present "Erosion Studies at Paricutin, State of Michoacan, Mexico" departed from the usual routine of most previous investigations carried on at Paricutin and concerned himself not with eruptions and closely related phenomena, but with forces already at work tearing down the cinder cone, lava flows and ash deposits.

Rainfall from brief, high-intensity storms during summer and autumn constitutes the maximum eroding force, he says. During the winter and spring the surface of the ash is so dry that the wind, usually from the west at that time of year, raises dust clouds almost daily. Before the eruption, about three-fourths of the area around the volcano was forested, chiefly with pines.

Paricutin erupted from a nearly flat field not far above the base of an older volcano, the north slope of Cerros de Tancitaro, on February 20, 1943. Within a year it had built a cone 1,000 feet high, although this height was increased by only about 75 feet during the next three years. Lava flows that followed were composed of basaltic andesite and were very blocky in nature. Thousands of square miles of the surrounding country have been mantled with fragmental volcanic rock most of which was spread out during the first year. The particles range in size from fine ash to pieces several inches in diameter.

Mr. Segerstrom reports that the ash is eroded, transported, and redeposited not only by water and wind but by mass movement as well, as evidenced by tilted forests (trees with their trunks growing at an angle illustrating ground creep), and by landslides, mudflows, stream-bank cave-ins, and faulting or shearing due to lava movement.

"Water erosion proceeds from the splashing of raindrops to sheet flow, thence to rill and channel flow", he says. "Most of the streams in the area are intermittent and are tributary to the westward-flowing Rio de Itzicuaro. Storms frequently swell them into dense, sediment-laden floods; then, as the flood velocity decreases, the sediment is redeposited in alluvial fans and on channel floors, on flood plains, and as sheet deposits."

Also noted are marked increases and decreases in the flow of springs in the area, brought about by changes in ground-water flow occasioned by the volcanic activity. The change in any particular locality, he says, depends on the effect of earthquakes, silting, water supplied from lava-trapped drainage, and changes in the water-table level and rate of evaporation.

CURRENT STATUS OF ATOMIC RAW MATERIALS

ROBERT J. WRIGHT
U. S. ATOMIC ENERGY COMMISSION

PART I OF A TWO-PART ARTICLE

Introduction

Man's use of the forces in the heart of the atom has focused unprecedented attention upon uranium, which is the basic fuel of atomic energy. Uranium is the fundamental ingredient of the atom bomb, and all present uses of atomic energy, both military and non-military, depend upon this element as raw material. There is also a second element thorium which eventually may be used for atomic energy, but insofar as we can see today, the role of thorium will be secondary to that of uranium. It is essential that an adequate supply of these two elements be maintained by the United States — otherwise our welfare may be placed in jeopardy.

Thorium

Small quantities of thorium are being used in atomic energy research. Its major use, as it was before the war, is still in the manufacture of certain kinds of optical glass and in the preparation of mantles for gas lights. The demand is small. Still, thorium has a long-range potential use as a source of fissionable material, and so the Atomic Energy Commission is currently assessing the nature, the grade, and the extent of the thorium resources which would be available to us when and if needed.

Most of the thorium used in this country is obtained by treatment of the mineral monazite. This mineral not only supplies thorium but is valued even more for its content of rare earth elements — such as cerium, lanthanum, and others. Monazite is a heavy mineral which may be concentrated by the action of running water along stream channels and by the action of marine currents along the sea shore. The placer deposits which are formed in this way are the world's chief source of thorium. In recent years, India and Brazil have been the leading producers, and only a little monazite comes from the United States.

Here in California, are potentially important thorium reserves. These deposits were formed in the same way as the famous gold placers which have yielded so much mineral wealth. The gold and the thorium-bearing minerals were freed from rocks in the Sierra Nevada by weathering and erosion and subsequently the heavy minerals were concentrated at various points along the stream channels descending into the Central Valley. In this way the Yuba, Stanislaus, Merced, Tuolumente, and other streams have formed placer deposits that contain gold, monazite, and other heavy minerals. Some of these placers are now being dredged for gold, and there is a possibility that with suitable concentration procedures monazite, and other minerals as well, might be recovered at a profit along with the gold.

To evaluate this possibility the U. S. Bureau of Mines has been making, on behalf of the Atomic Energy Commission, a study of the monazite reserves in California placers. The Bureau is also carrying out similar work in Idaho and other states.

So far as thorium is concerned, then, the demand is small and principally for commercial uses but the United States does have thorium resources of considerable strategic importance.

Uranium

The uranium situation is much more critical, since this element is the chief fuel of atomic energy. By way of introduction to our uranium supply problem, let us review the situation as it was immediately before the war — say in 1940. Then, let's see where we stand today, and I will try to point out some signposts which may indicate what our exploration and development will bring in the future.

By 1940 there were four great sources of uranium — the Erzebirge district in Europe, the Shinkolobwe mine in central Africa, the deposits at Great Bear Lake on the Arctic Circle in northern Canada, and the carnotite ores of our Colorado Plateau. The Erzgebirge district on the former German-Czechoslovakian border was the original source of uranium ore. This district had enjoyed a long and illustrious history, dating back almost to the Middle Ages. Joachimsthal, a town in the western part of Czecholovakia, was probably the most celebrated mining locality of the Erzgebirge. Silver mining began here in the 15th century. It proved so successful that a mint was established where silver coins, called "Joachimsthaler," were struck. The name "Joachimsthaler" was later contracted to "Thaler," a name which is still used for certain coins in various parts of the world and, incidentally, is the root for the American word "dollar." In the middle of the 19th century the little known, rare element uranium was discovered in the ores at Joachimsthal. At that time the chief use of uranium was in the manufacture of yellow and brown pigments for porcelain and staining glass. The uranium pigment industry was sufficiently important that the Bohemian Government built a plant for the production of these colors. Incidentally, a small amount of the uranium now used in this country for civilian purposes goes into the manufacture of yellow railroad signal lights, and a few pounds are used each year in coloring false teeth.

A residue obtained from the Joachimsthal uranium pigment plant was the material from which the Curies first isolated radium in 1898. Radium is produced during the radioactive decay of uranium. Under normal conditions radium is present in all uranium ore, but in very small amounts. In most ores the actual ratio of uranium to radium is about three million to one, which means that in preparing even a very small amount of radium large tonnages of uranium ore must be processed. When the unique properties of radium became known and the use of this element in medicine became established, uranium ores became valued not particularly for the uranium they contained but more especially for their radium content. The demand for uranium pigments was limited, and most

Fig. 1 — Significant uranium deposits of the world: Joachimsthal, Czechoslovakia (Erzebirge District); Shinkolobwe, Belgium Congo; Great Bear Lake, Canada; Colorado Plateau, United States; Lake Athabaska District, Canada. Courtesy of U. S. Atomic Energy Commission. (For a world map showing the location of 85 principal uranium occurrences, see the August 1949 EARTH SCIENCE DIGEST, p. 11.)

of the uranium processed in the refining of radium was never actually recovered.

The discovery of radium at Joachimsthal led to a marked revival of interest in the pitchblende ores of Joachimsthal and other mines of Germany and Czechoslovakia. A refinery was established to process radium-bearing ores, and for a number of years the mines at Joachimsthal held a world monopoly in radium production.

The grip of the Erzgebirge region on the world's radium supply was broken by the development of carnotite ores in the Colorado Plateau of the United States. These deposits contain both vanadium and uranium (and of course radium) and the mines have been worked at various times for these different metals, depending upon the market. The ores were first processed for radium. Some of the ore even found its way across the ocean to Bohemia for treatment in the refinery at Joachimsthal. By 1910 the Colorado Plateau led the world in radium output, and this area remained the leading source of uranium ore until the discovery of rich pitchblende deposits in the Belgian Congo. Competition with the African ore forced closure of most of the carnotite mines, although a few operations still remained active for vanadium.

The chief uranium-producing portion of Africa is in Katanga, a province in the southern part of the Belgian Congo on the Rhodesian border. The Katanga-Rhodesia area is a leading producer of copper, and it was exploration for copper that led to the discovery of uranium. Surface showings of yellow and green secondary uranium minerals at Shinkolobwe led to the discovery of pitchblende immediately under the soil cover. The rich ore bodies, which were developed in the early 1920's, permitted the Shinkolobwe mine to control the world's radium market for a number of years, until it too gave ground to a new discovery, a find on Great Bear Lake in the northlands of Canada.

Copper and cobalt mineralization had been recognized for a number of years on islands in Great Bear Lake, but the pitchblende-bearing veins escaped detection until 1930, when Gilbert LaBine examined showings of silver and cobalt on the lake shore. Many problems of climate, transportation, and engineering remained to be solved before production was started here a few years later.

We have seen that up to 1940, immediately before the war, most of the uranium produced in the world was recovered as a by-product of radium refining. The control of the radium ore supply leaped from continent to continent with the development of new deposits: first, the Erzgebirge region where radium was initially discovered; second, the carnotite deposits in our Colorado Plateau, then, the Shinkolobwe mine in the Katanga-Rhodesia copper belt of Africa, and, finally, the pitchblende-silver-cobalt veins on the barren shores of Great Bear Lake in northern Canada. In 1940 the mine at Great Bear Lake was closed, a victim of the problems of wartime operation, and world production of uranium ore was at a standstill.

To fill out the picture as of now, ten years later, let us first see what developments have taken place at the world's four great uranium producing areas. The Erzgebirge region in Czechoslovakia and Saxony passed first into German and then into Russian hands, and newspaper reports indicate the mines are now being actively exploited. The Shinkolobwe mine was unwatered and reopened during the war and is currently making an important contribution to our own uranium supply. The mine at Great Bear Lake was reopened in 1942 and it also continues to supply us with uranium ore.

In this country, the Colorado Plateau carnotites were worked intensively during the war for vanadium as well as uranium, and mining in the Plateau is actively going forward at the present time. These deposits still remain our largest proved domestic source of uranium. The deposits form scattered, tabular bodies of irregular shape and size in flat-lying sandstones of Mesozoic age. In particular, the Morrison formation is the host rock for most of the ore produced to date. Because of the irregular guides, the risks of exploration for new deposits are unusally high. In order to encourage development of the deposits by private capital, the Government is currently engaged in a diamond drilling exploration program. The drilling is of the incentive type, that is, the effort is made to outline favorable areas for more detailed exploration by private capital. At the same time geologic investigations are being made in an effort to outline guides which will be useful in later exploration. The drilling program and the geologic studies are being conducted by the U. S. Geological Survey and by the Atomic Energy Commission.

Canadian Developments

The past few years have seen several new and significant developments in the field of uranium supplies. In Canada, production is still primarily from the Eldorado mine at Great Bear Lake, but several other areas of uranium deposits also appear of interest and have production possibilities. Shortly after LaBine's discovery at Great Bear Lake, pitchblende was found two miles east of Gold-

Fig. 2 — Canada — showing main geological divisions and principal uranium occurrences (1 — Hazelton View. 2 — Gem. 3 — Eldorado Mine. 4 — Hottah Lake. 5 — Giauque. 6 — McLean Bay. 7 — Goldfields. 8. — Black Lake. 9 — Lac la Ronge. 10 — Camray. 11 — Wilberforce. 12 — Otter Rapids (thorium). From MINING ENGINEERING, February 1950; courtesy of U. S. Atomic Energy Commission.

fields on the north shore of Lake Athabaska. This discovery was neglected until after the war when active exploration was resumed. It has been found that the pitchblende-bearing deposits are both numerous and widely scattered; more than one thousand radioactive anomalies have been located within 10 miles of Goldfields. Exploration is being pursued actively and the Athabaska district is emerging as a potentially important uranium producer.

From the geologic standpoint, most of the deposits at Lake Athabaska appear to differ considerably from those at Great Bear Lake. The Great Bear Lake ore is complex and carries more than thirty minerals, including various sulphides, cobalt-nickel sulphides and sulpharsenides, hematite, and native silver. In contrast, many of the Lake Athabaska ores are simple. With few exceptions, the minerals associated with pitchblende include only hematite, chalcopyrite and other copper minerals, quartz, and calcite. Later, I will refer again to the unusual character of the Athabaska ore.

Beside the Lake Athabaska deposits, urainum-bearing veins have been found in several other areas of Canada. Several of these discoveries show a striking alignment along the margins of the Canadian Shield. By some, this is explained on very practical grounds as being the result of accessibility, the discoveries having been made near the large lakes that flank the Shield. Others feel that there may be an underlying geological reason — such as the fact that the deposits follow a belt of Proterozoic orogeny, and most of the pitchblende is of Proterozoic age.

[END OF PART I]

(This article was presented before the Mining Branch of the Southern California Section of the American Institute of Mining & Metallurgical Engineers in Los Angeles, Calif., June 14, 1950.)

The Supply and Demand for Geologists

There are over 11,000 geologists of professional rank from the United States, according to the report **The Supply and Demand for Geologists**, recently issued by the American Geological Institute.

The Institute's Committee on Geological Personnel, which compiled the report, summarizes the supply and demand for geologists as follows:

Petroleum geologists: Professionals employed, 7,697; Professionals required, 538; Sub-professionals required, 146.

Other economic geologists: Professionals employed, 500; Professionals required, 50.

Geologists in education: Professionals employed, 1,348; Professionals required 94.

Geologists in public service: Professionals employed, 1,518; Professionals required, 218; Sub-professionals required 182.

Others: Professionals employed, 400; Professionals required, 50.

Other estimates show that about 2865 geological personnel will have graduated college in 1950; about 2000 bachelors, 765 masters and 100 doctors; leaving an apparent surplus of about 1600 who may not find professional employment in geology. However, it is the opinion of the Committee that students of superior ability having one or more years of advanced training will continue to secure professional employment. "The solution to the problem of supply is the raising of standards so that the educational product will be, not in quantity, but of high quality."

Information Folder on Mapping Availible

WASHINGTON, June 25 — A new 5-color information folder on topographic maps designed and printed by the U. S. Geological Survey may be obtained free by addressing the Director, U. S. Geological Survey, Washington 25, D. C.

Well under way as a vital task of the Survey's Topographic Division, is the surveying, compilation and publishing of what is known as the National Topographic Map Series. The folder explains that this series includes (1) surveys of areas in which there are problems of great importance — relating, for example, to metropolitan and industrial sites; mineral development; dam and reservoir projects; irrigation or reclamation projects; (2) surveys of areas in which there are problems of average public importance, as in much of the agricultural land of the Mississippi Basin; (3) surveys of areas in which the development problems are regarded as of less magnitude or urgency, as in certain of the desert regions of the west (formerly made with only generalized detail).

One of the objectives of the Geological Survey is to supply ultimately a complete atlas of 15-minute topographic quadrangle maps at the scale of 1:62,500, covering the entire area of continental United States.

The folder contains information on map scales, features of topographic maps, aerial photographs, map accuracy specifications, state plane coordinate systems, and extent of areas mapped. A complete list of topographic map symbols is included.

A GEOLOGIST VISITS EUROPE — BOTH SIDES OF THE "IRON CURTAIN"

HORACE G. RICHARDS
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It was with considerable interest that I received, early in 1949, an invitation to attend the Congress of the International Association on Quaternary Research (INQUA) to be held in Budapest, Hungary, in September of that year. In spite of the fact that Budapest was well behind the "Iron Curtain", it was pleasing to note that the Hungarian geologists were contemplating an international congress to discuss problems relating to the Pleistocene and early man. I quickly accepted the invitation and made plans to fly to Budapest in the late summer of 1949.

I looked forward not only to the conferences and field trips planned for the Congress, but also to the opportunity of meeting and talking with scientists who were working on Quaternary problems in various European countries and who would be attending the Congress in Budapest.

With considerable regret I received word in May (1949) that the Congress was to be indefinitely postponed for reasons never entirely explained.

Having already made reservations to fly to Europe, I decided to continue with my plans as far as possible and to visit some of the would-be delegates of the INQUA Congress in their respective countries. I had in the meantime received cordial invitations from some of these geologists, especially in England, France, Poland and Czechoslovakia. I therefore planned an itinerary which would include visits to these various countries as well as brief stops in several others. (Time would not permit a more elaborate program.)

I was particularly glad to receive the invitations from Poland and Czechoslovakia because I wanted to prove to myself that the "Iron Curtain" was not quite as impenetrable for scientists as it was for politicians and newspaper men. Visas were granted with no difficulty whatever, and while my stay in Poland was restricted as to time, it did allow opportunity to visit scientists in Warsaw and to take several brief excursions.

I flew in a Stratocruiser from Idlewild Field, New York, on Aug. 22, and the following morning was in London. While my stop in London was limited to overnight, I did have a chance to spend a few days in England on my return trip; therefore for convenience a brief mention of my English excursion will be given here.

A field trip was arranged by the Geological Survey of Great Britain to Felixstowe on the North Sea some 85 miles northeast of London. Along this coast the Red Crag formation is well exposed overlying the London Clay of Eocene age. The Red Crag deposits were formerly classified as Pliocene, and were of considerable importance because of the "eoliths" (questionable human artifacts) found in the formation, notably near Ipswich. As a result of discussions held at London in 1948, the prevailing opinion is that these crag deposits are of early Pleistocene age (Villafrancian). While no attempt was made to settle this controversial problem on one brief field excursion, I had an opportunity to discuss that matter with my host and guide, Mr. M. A. Carver, and to collect numerous marine fossils from the outcrop.

FRANCE

In France I was the guest of M. Francois Bordes of the Institut de Paleontologie Humaine of Paris. We first went to Amiens to examine the terraces of the Somme River, where we had the opportunity to collect artifacts from the Acheulian and Mousterian cultures, and to make observations on the loess and gravel deposits. Another trip took us to the terraces of the Seine on the outskirts of Paris, where we again collected artifacts and loess fossils.

The highlight of my sojourn in France was a trip to the cave region of Dordogne in southwestern France. We took the night train from Paris to Les Eyzies where we were fortunate in meeting Mr. Smyzer of the U. S. Consular office in Bordeaux, who invited us, as well as some visiting French archaeologists, on a drive through the cave region of that province. Stops were made at several Paleolithic caves and shelters, including Moustiere, the type locality of the Moustierian culture. The climax of the excursion, however, was a visit to the cave of Lescaux at Montignac with the beautifully colored paintings of the horse, reindeer, bison and other animals drawn by Paleolithic Man. The exact age of the cave culture is unknown, but it is at least as old as the last glacial stage (25,000 years) and it is probable that several different cultures are represented in the cave. This cave, was not discovered until 1940, has only been partially excavated, and it is certain that some valuable information on Paleolithic Man will be derived from further studies in the inner recesses of this cave.

Photo by Horace G. Richards

Fig. 1 — Collecting Mousterian artifacts from gravels near Amiens, France.

GERMANY

From Paris I took the famous "Orient Express" eastward into Germany.

I had originally planned to spend several days visiting scientists and consulting museums in Frankfurt and Wiesbaden, but because of a delay in receiving mail with specific information, I decided to omit this part of the trip, and to spend a few days resting and sightseeing among the ruins of Nuremberg.

Nuremberg was in holiday mood because of a Folk Festival which was taking place in the city. While this added color to my visit, it presented a slight difficulty in finding a place to stay in the much bombed city. However, a room was found in the newly reopened Hotel Deutscher Hof.

CZECHOSLOVAKIA

After the brief stop-over in Nuremberg, I continued on the

"Orient Express" eastward through Bavaria to Czechoslovakia. The crossing of the "Iron Curtain" between Strinding, Germany, and Cheb, Czechoslovakia was without incident.

That same evening I arrived in Prague where I was most cordially received by the family of one of my Czech friends. A very pleasant program had been planned for me by these friends as well as by the geologists of Charles University, the National Museum and the Geological Survey of Czechoslovakia.

One of the excursions took me through the Cretaceous and Quaternary (loess) deposits of central Bohemia. The former were of special interest to me because of the many similarities between the Cretaceous geology of Bohemia and that of New Jersey where I had been making some special studies. A side trip on the Bohemian excursion took me to Lidice, one of the saddest sights in all Europe. It was inspiring to witness the building of the houses of the new Lidice for the survivors of that awful massacre.

It was interesting to note that in spite of the relatively poor economic conditions and the pressure of the new regime, scientific work was going ahead at a rather rapid rate.

Contrary to what might be supposed, not all geological work was directed toward economic or military goals, but a large percentage was concerned with such matters as detailed geological mapping, petrological studies and the correlation of fossil faunas. Activities in the uranium deposits between Prague and the Saxony border are obviously highly secret, and are under the direct supervision of Russian scientists.

After a pleasant few days in Prague, I again borded the "Orient Express" for a trip through Bohemia and Moravia to the Polish border.

POLAND

I arrived in Warsaw the following afternoon and was met at the train by Dr. B. Halicki, of the Muzeum Ziemi, one of the leading Pleistocene geologists of Poland. Again, a very strenuous program had been arranged, and it was difficult to find time to do all the things planned by my Polish friends.

Probably the most vivid impressions of my entire trip were made by a walk among the ruins of Warsaw. In spite of the fact that this city had been almost totally destroyed by the Germans during the war (estimates vary from 70% to 95%), I found Warsaw one of the most vital and alive cities that I visited in Europe.

Later that evening I was entertained at a small gathering at the University of Warsaw where I had the opportunity to meet the eminent paleontologist Dr. Kowlowski (authority on the graptolites) and several other Polish geologists. Conversation was a little difficult, being maintained in three languages (Polish, English and French — German being entirely taboo), but among other things I learned that I was the first American geologist to visit Warsaw for ten years.

After a morning given over to "red tape" (visa extension, exchange of money, etc.) I was taken on an automobile trip across the Vistula to visit some of the Quaternary deposits east of Warsaw. Among other places we visited Paleolithic and Mesolithic sites at Swidry Wielkie, where we had the opportunity to collect a few chips. The sand dune country east of the Vistula reminded me so much of the New Jersey Pine

Photc by Horace G. Richards

Fig. 2 — Excavating at Biscupin, Poland

Barrens that I almost thought that I was back home.

Again, I was very much impressed with both the quantity and quality of scientific work being done by these Polish workers, especially in the fields of geology and archaeology. In fact every time that I visited a museum or university in Poland, I was presented with a large package of books and pamphlets to take back home to show what Polish scientists have done since the liberation of their country.

Another trip took me west into the Province of Poznan where I had the opportunity to visit the excavations of the Iron Age village site of Biscupin. This work, which is being done under the direction of the Institute of Pre-Slavic Culture of the University of Poznan, is a great interest and is bringing to light valuable information about the Lausitz culture of the Iron Age (500 to 300 B. C.) and is confirming the belief that the original homeland of the Slavs lay in the region between the Oder and the Vistula.

The question of whether the Lausitz Culture was more closely tied to the ancient Slavs or ancient Germans has long been a matter of controversy. Most German scientists claimed it to be pre-Germanic or pre-Illyrian with the homeland of the Slavs lying considerably to the east (in White Russia); Polish and Czech workers, on the other hand, maintain that the Lausitz folk were the direct precursors of the Slavs. The use of archaeological evidence in justifying the present Polish or German ownership of the provinces of Poznan and Pomerania is of course obvious.

From Biscupin, I went to Poznan, and then took the train through the "Recovered Territories" to Szczecin (formerly Stettin) and Odraport on the Baltic (formerly Sweinnemunde).

At Odraport, the boundary between present Poland and the Russian zone of Germany, I bordered

Photo by Horace G. Richards

Fig. 3 — Part of breakwater and foundations of houses at Iron Age village of Biscupin, Poland.

the car ferry for the nine hour trip across the Baltic to Trelleborg, Sweden. So, as I stepped on the boat, under a Swedish flag, I realized that I had now penetrated the "Iron Curtain" in both directions without even the slightest unpleasant experience.

SCANDINAVIA AND HOLLAND

Sweden seemed very prosperous after Poland and Czechoslovakia. However, much as I would have liked to stay, I could only spend one day in Malmo before taking the boat to Copenhagen.

I had hoped to have time to collect from the Interglacial marine deposits at Eem in Denmark; however, the time for my return to America was drawing close, and I merely had time for two brief excursions from Copenhagen before taking the plane for Amsterdam.

The single field trip arranged in Holland was to the coast of the North Sea at Zandvoort, primarily to collect modern sea shells. I noted a large number of black, worn shells on this beach, reminding me of those Pleistocene specimens washed onto the beaches of New Jersey and North Carolina. After consultation with some Dutch Pleistocene geologists, I am of the opinion that the same condition prevails along the North Sea coast of Holland as that along the Atlantic coast of the United States, namely that some marine Pleistocene deposits occur beneath the floor of the sea and fossil shells from these deposits are occasionally washed onto the beaches. The exact age of these is uncertain; some may be postglacial, others interglacial (Eem).

SUMMARY AND IMPRESSIONS

And so, the trip came to an end. From Amsterdam, I flew across the Channel for another stop in London, and then by Constellation across the Atlantic. Only four weeks had elapsed since I had left

New York, but thanks to the speed of modern air travel and the kindness of my European friends in arranging all the details of reservations and field excursions, I had been able to travel through nine countries (including a one hour stop in Eire).

Many impressions were gained from the trip, some favorable, some definitely unfavorable, but the lasting impression was that the friendship of the individual European people whom I met (in all countries, barring none) was still very great, and had not been destroyed by change in government, political propaganda, or any other means.

My trip made no pretense of being a thorough survey, either of the scientific work or the political situation. Nevertheless, it is pleasing to report that many phases of research, in particular those dealing with Quaternary geology and Early Man, are proceeding at a good rate. I was also able to prove to myself that at least certain portions of the "Iron Curtain" were not entirely impenetrable to one of my field. Whether or not it would have been possible to penetrate deeper into Eastern Europe cannot be determined, for I made no attempt to do so. Whether the trip could be repeated another year is also problematical and will depend upon conditions of the "cold war". It was the fervent wish of all scientists encountered on both sides of the "Iron Curtain" that world conditions will improve so that international cooperation will be resumed on an ever-increasing scale.

(Condensed from the General Magazine of the University of Pennsylvania.)

Cushman Collection of Foraminifera Available For Study

WASHINGTON, July 10 — The Cushman Collection of Foraminifera, well know types of microfossils, has been received and housed at the National Museum in Washington following shipment from Sharon, Massachusetts.

Miss Ruth Todd, who had charge of the collection in Sharon, has been transferred to Washington as a member of the Paleontology and Stratigraphy Branch of the Survey. From 1940 until his death in 1949, she was associated with Dr. Joseph A. Cushman, founder of the private foraminifera laboratory whose contents were willed to the National Museum. She collaborated with him in his most recent publications and will continue to work with the collection.

Dr. Cushman too, was a member of the Geological Survey from 1912 to 1921 and again from 1926 to the time of his passing. His early work as a consultant specialist on tiny, single-celled marine animals known as Protozoa, brought him into association with the former Survey section of Coastal Plain Investigations under Dr. T. Wayland Vaughan. In this work he was called upon for expert judgment in determining the geologic age of sedimentary rock formations by means of the minute shells of foraminifera that were buried with the sediment.

Then came attempts to correlate similar stratigraphic horizons in wells being drilled in South Carolina to obtain water. Because it was possible to determine the geologic age and sequence of rocks through which a drill was passing by matching these Foraminifera (certain forms of which are characteristic of certain geologic ages and are found in no others) it was only a step further to apply such knowledge to guiding the men who drill for oil.

When Dr. Cushman started his work with the "Forams", it was with no thought of any practical, economic use for his studies. These animals, whose remains form some of the ocean bottom oozes in modern seas, and solidified in ages past to form the layers of Mesozoic and Tertiary limestone so popular with builders from pyramid days on down, offered a scientific challenge to the then youthful scientist. Cushman specialized in classifying them into neat pigeonholes according to family, genera, species, and geologic age.

When the economic value of such correlations became apparent to him, he resigned for a time from the Survey, and engaged in studies of Forams in Mexico for an oil company. The story of his phenomenal success there has often been told. Foraminifera jumped suddenly from obscurity into the limelight as fewer and fewer "dry holes" were drilled. Today this use of geology in searching for oil is common practice; another instance where so-called "pure research" of no commercial value suddenly became a tool of great economic importance.

Most people would have capitalized on this success, but Dr. Cushman was more interested in research than monetary rewards. He returned to Sharon and continued in his oil consulting work for a few years, investing his earnings in the construction of an adequately equipped scientific laboratory and making two trips to Europe to study important type specimens there.

In 1926 he again joined the Geological Survey as a sort of "dollar a year" man, to have a good excuse for not accepting commercial work. For 23 years he made himself and the resources of his laboratory available to Harvard students, adding tremendously to the prestige and effectiveness of the geology department in his Alma Mater. First appointed lecturer in Micropaleontology, his appointment was later changed to Research Associate.

His collection is still being unpacked at the Museum, together with its accompanying card catalogue and an extensive library of more than 4,000 items on Foraminifera. There are more than half a million specimens mounted on 150,000 microscope slides. Some 13,00 are irreplaceable type specimens, and were brought down from Sharon via special truck. They constitute holotypes, specimens chosen by the author as most characteristic of species he describes; paratypes, additional specimens from the same or adjacent locality chosen to supplement the holotype; and plesiotypes, subsequently figured specimens chosen by students who come along later. More than 98,000 species cards comprise the collection index.

Another highly prized part of the collection is a complete set of Foraminifera models made by D'Orbigny in 1826, still valuable as an aid to teaching. D'Orbigny was the first to recognize that these tiny creatures were Protozoa, minute single-celled animals, not merely small editions of molluscs.

"Torture Chamber" Yields Clues To Earthquakes' Causes

LOS ANGELES, June 3 (Science Service) — A scientific "torture chamber" recently completed at the University of California at Los Angeles is being used to learn how mountains and oceans were formed, to understand what causes earthquakes, and how to locate precious metal and petroleum deposits.

One of the machines in the laboratory will squeeze rocks with a pressure of 150,000 pounds per square inch. This is equivalent to the pressure that exists 22 miles below the continental crust, seven times deeper than man has penetrated.

After such giant pressures, rocks are examined under the microscope. The "creep" or "flow" of the rocks' structure, it is thought, may be responsible for some earthquakes and continent-building. A study of the mechanism of rock fractures is expected to be of help in locating precious metal deposits.

Another device in the laboratory "makes" rocks. Loose sand can be compressed so tightly that it becomes solid quartzite. This study of sand compaction may furnish information about the flow of oil and provide valuable information in the field of petroleum geology.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

GEOLOGY OF THE FISSIONABLE MATERIALS. George W. Bain. **Economic Geology,** Vol. 45, No. 4 (June-July 1950), pp. 273-323. "Deposits of uranium and thorium have characteristics of mineralogy and geologic occurrence with geographic distribution pattern that facilitates estimating the resources in each type. Positions for known geographic occurrences are shown on maps and the geologic control over the distribution for each type is reviewed in the text. Aggregate abundance in the earth is about that for tin and theoretical difficulty of recovery from large deposits would appear to be slightly less than for silver." The geological associations of uranium and types of uranium deposits are discussed. The resources of producing and potential producing countries are described in detail.

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AN INTERPRETATION OF FLORIDIAN KARST. Richard H. Jordan. **Jour. Geology,** Vol. 58, No. 3 (May 1950), pp. 261-268. A highly developed system is present in peninsular Florida extending to depths of thousands of feet. Artesian springs and some sinks may have been formed either in part or wholly by the flowing of the water through open passages and in certain regions moving up-dip, transecting various strata. Widespread sink formation by vadose and nonartesian ground water may have taken place due to lowered sea level during the Pleistocene. Caverns were formed by flow in completely water-filled passages beneath the water table, similar to those furnishing water to the present deep springs, during a Pleistocene interglacial stage when the sea level was higher.

PLEISTOCENE LITHOLOGY OF ANTARCTIC OCEAN-BOTTOM SEDIMENTS. Jack L. Hough. **Jour. Geology,** Vol. 58, No. 3 (May 1950), pp. 254-260. Ocean-bottom core samples from the Ross Sea, Antarctica, obtained during the U. S. Navy Antarctic Expedition of 1946-47 consist of alternations of glacial marine sediment and non-glacial (?) fine-grained sediment, recording periods of from 170,000 to over a million years. A comparison with the Northern Hemisphere record indicates that glaciation was contemporaneous in the two hemispheres.

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SOIL. Charles E. Kellogg. **Scientific American,** Vol. 183, No. 1 (July 1950), pp. 30-39. The five factors shaping the evolution of a soil are (1) the parent rock, (2) relief, (3) climate and (4) living matter, acting on the parent materials, and (5) time. Soil horizons are usually mixtures of sand, silt, and clay, along with some organic matter. Soil components, chemical activity, and erosion are discussed. The Gray-Brown Podzolic, Clarion, Chernozem, Podzol, Tundra, tropical, and desert soil groups are discussed in detail. There are some 40 great soil groups on the earth. Soil maps of the U. S. and the world are presented.

COVER PHOTO

This month's cover photo is of the Frozen Fountain at Luray Caverns, Luray, Virginia. Water containing dissolved calcium carbonate is dripping onto the "frozen fountain" of stalagmites. For a complete discussion of the growth of stalactites and stalagmites, read **The Cave Book** (see p. 22).

TEACHING THE EARTH SCIENCES IN THE SECONDARY SCHOOLS

(PATR THREE OF A THREE PART REPORT)

JEROME M. EISENBERG

The following report is based upon the papers and discussion presented at the Conference on the Teaching of the Earth Sciences in the Secondary Schools, sponsored by the Earth Science Institute, and held at Boston University, March 17-18, 1950. The discussion was recorded by Miss E. Louise Jewell. Both the papers and discussion have been edited and condensed in three parts by the Editor in order that we may present the entire report.

Principal participants in Part Three of the Conference report were:

John S. Barss, Phillips Academy, Andover, Mass.

Jerome M. Eisenberg, Earth Science Institute, Revere, Mass.

Mary E. Mrose, Harvard University, Cambridge, Mass.

Edmund M. Spieker, Ohio State University, Columbus, Ohio.

Donald B. Stone, Mont Pleasant High School, Schenectady, N. Y.

Hugh Templeton, New York State Education Dept., Albany, N. Y.

H. P. Zuidema, University of Michigan, Ann Arbor, Mich.

MECHANICS OF EARTH SCIENCE EDUCATION

EARTH SCIENCE PUBLICATIONS FOR THE SECONDARY SCHOOLS

(Abstract)

JEROME M. EISENBERG
Earth Science Institute

The two outstanding textbooks on the earth sciences written especially for the secondary school student are:

Earth Science, a Physiography, by Gustav L. Fletcher (1943, Revised Edition; D. C. Heath).

The Earth and its Resources, by V. C. Finch, Glenn T. Trewartha, and M. H. Shearer (1948, 2nd Edition; McGraw-Hill).

These two one-semester college survey course texts might well be adapted for use as high school texts:

Earth Sciences, by J. Harlan Bretz (1940; John Wiley & Sons).

Fundamentals of Earth Science, by Henry D. Thompson (1947; D. Appleton Century Co.).

Our Amazing Earth, by Carroll Lane Fenton (1938; Doubleday & Co.), and **This Puzzling Planet**, by Edwin T. Brewster (1942; Bobbs-Merrill Co.), are both entirely devoted to geology, and are rich in historical geology and the historical development of the geological sciences, as compared to the previously named texts, which contain extensive sections on meteorology, climate, astronomy, etc. Although they were written primarily for the average laymen, they might be used for high school courses, especially since they provide interesting reading.

The best laboratory manuals and workbooks are:

Workbook and Laboratory Manual in Earth Science (Physiography), by Donald B. Stone (1946, Revised Edition; College Entrance Book Co.).

Student's Guide in Earth Science, by B. T. Diamond (Oxford Book Co.).

Laboratory Exercises in Physiography, by Gustav L. Fletcher (1947, Revised Edition; D. C. Heath).

Physiography Laboratory Sheets (Earth Science), by W. B. Nelson (Globe Book Co.). The latter two are laboratory manuals only.

Other books recommended for the student on physical geology, historical geology and mineralogy, are:

Animals of the Past, by F. A. Lucas (1929, A.M.N.H.).

Before the Dawn of History, by C. R. Knight (1935, McGraw-Hill).

The Book of Minerals, by A. C. Hawkin (1935, Wiley).

Getting Acquainted with Minerals, by G. L. English (1934, McGraw-Hill).

How Old Is the Earth, by C. A. Reeds ,1931, A.M.N.H.).

How the Earth is Changing, by R. Bretz (1936, Follett).

Life Long Ago, by C. L. Fenton (1937, Reynal).

Life Through the Ages, by C. R. Knight (1946, Knopf).

Minerals, by H. S. Zimm and E. K. Cooper (1943, Harcourt, Brace).

Minerals and How to Study Them, by C. S. Hurlbut, Jr. (1949, Wiley).

Mountains, by C. L. and M. A. Fenton (1942, Doubleday).

Old Mother Earth, by K. F. Mather (1928, Harvard Univ. Press).

The Rock Book, by C. L. and M. A. Fenton (1942, Doubleday).

Sons of the Earth, by K. F. Mather (1930, Norton).

Stories in Stone, by W. T. Lee (1927, Chautauqua).

The Story of a Billion Years, by W. O. Hotchkiss (1932, William & Wilkins).

The Story of Earthquakes and Volcanoes, by G. Johnson (1938, Messner).

The Story of the Great Geologists, by C. L. and M. A. Fenton (1945, Doubleday).

Volcanoes — New and Old, by S. H. Coleman (1946, John Day).

The World of Fossils, by C. L. Fenton (1933, Appleton-Century).

Popular publications on regional geology may often be obtained from state geological surveys, and universities and colleges. The Earth Science Institute is planning to issue a series of small guide books on the geology of individual states, accompanied by planned field trips.

The Directory of Geological Material in North America, by J. V. Howell and A. I. Levorsen (Bulletin of the American Association of Petroleum Geologists, August 1946), contains a comprehensive listing, by states, of sources for publications, maps, libraries, guide books, etc.

The principal periodicals of a non-technical or semi-technical nature are:

The Earth Science Digest, Revere, Mass. (Earth sciences).

The Mineralogist, Portland, Oregon (Mineralogy, gemology).

Rock and Minerals, Peekskill, N. Y. (Mineralogy, mineral collecting).

A large number of popular mimeographed periodicals are issued by local and regional earth science societies.

Over 650 bound books and a large number of current earth science periodicals are available for the use of earth science teachers in the library of the Earth Science Institute. These publications may be borrowed for periods of one to two months.

(Ed. note: The American Geological Institute, 2101 Constitution Ave., N. W., Wash. 25, D. C., has just issued a list of 625 selected books and pamphlets, mostly non-technical, on the earth sciences, with occasional annotations, "The Earth for the Layman" is available at $1.00 per copy prepaid.)

VISUAL AIDS FOR THE EARTH SCIENCES (Abstract)

H. P. ZUIDEMA
University of Michigan

2x2" slides are invaluable as a means of introducing geologic features in high school earth science courses where field trips are not held very often, if at all. They may be used to give comprehensive "recognition" examinations Any school may inexpensively assemble a good working collection of slides of local features with a 35 mm. camera.

There are a number of excellent motion pictures on purely geologic subjects for use in high school courses. The text **The Earth and its Resources,** by Finch, Twewartha, and Shearer (1948, 2nd Edition; McGraw-Hill), contains a comprehensive list of films with their running times, scope, and addresses of the principal producers and distributors.

The filmstrip is acknowledged as the simplest, most direct, and least expensive visual aid for mass instruction yet devised. The film consists of a strip of cellulose acetate, 35 mm. wide and from 2 to 5 feet in length, with a number of individual frames. They may carry brief text and captions, or sound may be provided through records. A few examples of geological filmstrips are: **Dinosaurs,** 34 frames with script and guide, $2.00 (Society for Visual Education); **Our Earth is Changing,** 68 frames with text, $4.50 (Jam Handy Organization); **Story of Glaciers,** 34 frames with text, $2.50 (Society for Visual Education).

Among the principal filmstrip producers are.

American Council on Education, 744 Jackson Pl., Wash., D. C.

Eye Gate House, 330 W. 42nd St., N. Y. 18, N. Y.

Filmette Co., 635 Riverside Dr., N. Y. 31, N. Y.

Jam Handy Organization, 2900 E. Grand Blvd., Detroit 11, Mich.

Photo Lab, U. S. Dept. of Agriculture, 3825 Georgia Ave., N. W., Wash. 11, D.C.

Society for Visual Education, 100 E. Ohio St., Chicago, Ill.

Stillfilm, 8443 Melrose Ave., Holywood 46, Calif.

A useful volume for the earth science instructor is **Visual Aids, Their Construction and Use,** by Weaver and Bollinger (1949, Van Nostrand).

PREPARATION OF TEACHERS FOR COURSES IN EARTH SCIENCE EDUCATION

Dr. Spieker: Geology, as far as I know, is the least fool-proof of the major areas of science. You can demonstrate that to your own satisfaction or that of any competent geologist by opening almost any book of general scope in which geology is treated at all. If the chapter on geology was written by a non-geologist you will not read far before you find some egregious error.

If we are to equip a person to teach geology on any level, it is rather an ambitious undertaking.

But I must not be too discouraging. I might perhaps venture — no more than that — this suggestion: that the prospective teacher of secondary school earth science be given a good, thorough grounding in the major elements of geology as a whole, including certain parts of mineralogy and paleontology. This is not easy to do. I think that the student should be encouraged much more strongly than we encourage the college student in general to go on after graduation to continue his education.

The main thing college can do for them is to teach them how to learn. When former students say to me that they wish they had had a course in geology while in college, my stock answer is: "You can read, can't you?"

Miss Mrose: After having taught geography for fourteen years I finally took a few courses in geology for the fun of it. I injected geology into my junior high school classes wherever I dared and wherever I could do so in the 7th grade course. The children were fascinated by it. They liked geography but they loved what they got in geology. Limitations of the course of study prevented my carrying it very far but it did not deter the boys from studying after school, bringing in specimens, and so on, until it became a course in geology after school hours. I taught there until the principal told me he had a plan for me — to teach history. I left teaching then and pursued geology on a full-time schedule.

How can we introduce geology into

junior high school? It could be injected into geography courses. However, it may require a revamping of geography courses in order to do that. Treating geology in geography is difficult in that few teachers have ever been prepared to teach geography; a great many of them started off by being English or chemistry majors. When without a job, they took what happened to be open. In a situation like that a course in geography resolves itself into a reading course: the teacher reads a chapter and then asks questions on it.

In junior high, we have the possibility of elective courses as early as the 8th grade, and I see no reason why an elective course in earth science could not be offered.

Probably the best way we can try to foster this movement in junior high school is to do something about the formation of earth science clubs. Junior high schools usually have active club programs, and it is difficult to decide what clubs to offer. This might well be answered in an earth science club, provided that the proper instructor or someone to guide it is available. It is my thought that the Earth Science Institute might foster this by presenting material in some important magazine whereby we could show what outline they might follow and suggest a model program for the year, etc. In the clubs you would have opportunity to bring in speakers — mineral collectors, geologists from nearby universities; and conduct field trips and visit museums during the winter months.

I hope that something will be done to encourage teachers' colleges at least to provide prospective teachers with a background in physical and historical geology. I honestly don't see how anyone could expect a teacher of geography to go without these courses.

Mr. Barss: There is a great need for the preparation of teachers of the earth sciences in the secondary schools, as I don't suppose we can expect to have professional geologists fill these jobs. We have to have people who specialize in something alse — perhaps specialize in teaching. I am not personally interested in courses in teaching, but I would be sorry to see anyone try to teach earth science without knowing at least a little about physics, chemistry, biology, and as much as possible of things which are not scientific, because the breadth of an individual is his ability to weave together threads which are not obvious at first glance, and this to my mind is a very important part of a teacher's ability. I am distressed at the number of times I see requests from journals circulated among teachers for units to teach this and to teach that. I am distressed about it because I think it indicates that our teachers in general are not teaching what they can teach. I don't suppose that a person who fingers his well-worn geology textbook really needs any unit in teaching running water.

I am a research chemist of one year's research; I am a physics teacher who never had a course in physics; I am a teacher of earth science who had but a half-year course in geology. I think I have been strengthened rather than weakened in the jobs I am doing because I have been trained as a chemist rather than as a physicist or geologist, for it has given me more breadth.

Mr. Templeton: What do we ask in New York state of any science teacher? One thing is eighteen hours of education. Another is a total of twelve hours in biology, twelve hours in physical science, and six hours of electives — and these include earth science — even written into the regulations. We would like far more than that, and we get more than that from some people. I mentioned this morning that I had seen boys coming into teaching with eighty hours of science **and** eighteen hours of education; and we find that the very enthusiasm which got them to take eighty hours is more valuable than what they got out of the eighty hours of course work.

In earth science we are horribly undermanned. We have approximately one hundred and ten teachers qualified by any standards. We are encouraging colleges to point out to their prospective teachers that earth science is one of the best subjects in which to get a position and indicate to them that some knowledge of geology would be to their advantage. I can say that for every young man or young lady who might teach science in New York state, it would be advisable to have at least twelve hours of geology and earth science in a very broad over-all training, since most of the jobs are in small schools upstate.

We look for a well-rounded training in science. We certainly need far more work in earth science than we are getting today. We have a long way to go in earth science in New York. The little success we have had is very spotty.

Dr. Stone: My experience with earth science teaching and teachers in New York State is this: that 90% of the success of the classes given by the New York teachers is due to their interest. If they have that and a good well-rounded background, and are "natural born teachers" they have good results. As I pointed out this morning, of the twenty-five best earth science teachers in the state, four or five have had no geology at all.

I am an example of a one-science teacher, with a minor in other sciences. In most schools the science teacher is going to teach from two to four things and they have got to have enough of all the sciences.

For earth science, with one or two courses in the geology department they can get sufficient training for teaching the course.

Every individual who expects to teach general science should take enough physics and biology to enable him to teach these subjects as well as his geology. He should be prepared in these subjects. In some cases he should be prepared to go into a school system where there is no earth science given whatsoever and in the course that he finds there gradually introduce it. Earth science courses have developed in those schools where teachers were equipped or where their interest was aroused.

U. S. Water Record For May Shows Extreme Variance

WASHINGTON, June 9 — There was either too much or too little water in many areas of the United States during the month of May, according to the May issue of the U. S. Geological Survey's Water Resources Review.

Melting of the remaining snow cover in the Dakotas-to-Ontario region, together with heavy rains, caused new floods of record-breaking proportions in the same area where outstanding floods occurred in April. Moderate to serious floods occured also in scattered areas from Iowa to Texas. However, the runoff was generally deficient over much of the Southwest, particularly in California, Arizona and New Mexico, as well as in Maine, the Maritime Provinces, and Quebec.

In New York, runoff was slightly below normal over the State, with some improvement noted in New York City's water supply situation. As of June 4, the city's reservoirs were reported at 93 percent of capacity. However, groundwater levels were generally below normal in upstate New York, except in the Hudson and lower Mohawk Valleys. Unless above-normal precipitation occurs, levels in wells in northern and western New York are expected to be uncomfortably low by late summer.

In the Northwest, where danger of floods was reported in April, the situation improved somewhat. No excessive runoff has occurred yet, except in the Spokane River Basin. With warm days and cold nights during May, the prospect of great floods, compared with a month ago, has diminished.

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*THE ART OF THE LAPIDARY

Francis J. Sperisen. 1950. x, 382 pp., 1 pl., 406 figs.; $6.50. (Bruce Publishing Co., Milwaukee). An outstanding book on the many phases of the lapidary art, including cabochon cutting and polishing, faceting, drilling, engraving, carving, sculpturing, mosaic, inlay, parquetry, and diamond polishing. Clear, concise chapters on the physical characteristics and classification of gems present an excellent introduction to this work. The illustrations and treatments of cabochon cutting and polishing, and faceting, are superior to those we have seen in other lapidary books. Reference lists, tables, and a glossary are included.

*THE CAVE BOOK

Charles E. Hendrix, 1950. 68 pp., 34 figs.; $1.00. (Special Pub. No. 1, Earth Science Institute; Earth Science Publishing Co., Revere, Mass.). The hobby of spelunking; the various types of caves; dripstones; theories of cave formation; cave photography, mapping, and surveying; and commercial caves — all are treated thoroughly in this well-illustrated booklet, the first in a series of popular publications to be issued by the Earth Science Institute. This book is an outgrowth of the author's article "Exploring the Mysterious" in the Sept. and Oct. 1948 issues of the **Earth Science Digest.**

*GEOLOGY FOR ENGINEERS

Joseph M. Trefethen. 1949. xii, 620 pp., 242 figs.; $5.75. (D. Van Nostrand Co., N. Y.). An excellent presentation of the fundamentals of geology for the engineering student. Especially useful are the chapters on geologic maps, geologic interpretation of topographic maps and airplane photographs, geophysical exploration in engineering, and dam sites and reservoirs. The appendices present sources of geologic information, physical properties of some common rock types, and extensive tables for the identification of some of the common minerals.

*HYDROLOGY

C. O. Wisler and E. F. Brater. 1949. xii, 419 pp., 132 figs.; $6.00 (John Wiley & Sons, N. Y.). The central theme of this book is stream flow, its fluctuations and the causes thereof. Following an introduction to the characteristics of the hydrograph (the graphical representation of the fluctuations of a stream in flow arranged in chronological order) and with the factors affecting it, the drainage basin, precipitation, water losses, infiltration, ground water, runoff, floods, and stream-flow records are presented. It fulfills admirably its purpose of serving as a textbook for college and university use.

*NORTHWEST GEM TRAILS

H. C. Dake. 1950. 80 pp., 14 figs.; $2.00. (Mineralogist Publishing Co., Portland, Ore.). A collection of articles on gem localities in Oregon, Washington, Idaho, Montana, and Wyoming, concerned primarily with agate, petrified wood, and northwestern U. S. mineral collectors. Chapters are devoted to each state, as well as to a "special northwest tour". It is in need of organization and indexing.

FORTHCOMING ARTICLES

Sedimentation Studies at Lake Mead, by Herbert B. Nichols.

A Glossary of Mineral Species, by Jerome M. Eisenberg.

Prospecting for Ores by Geochemical Methods, by Jerome M. Eisenberg.

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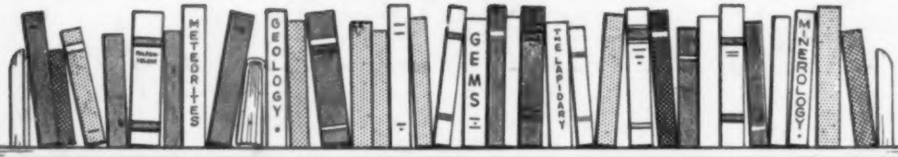

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[We pay postage in the United States]

OUR TEN "BEST SELLERS"

Since we began to advertise our complete catalog of books on the earth sciences, which appeared in the Earth Science Digest from June 1949 to January 1950, we have found the following ten books to be the ones most in demand by our readers from the list of over 250 titles:

1. THIS EARTH OF OURS by C. W. Wolfe. 1950. 384 pp., illus. .... $ 5.00
2. HANDBOOK OF URANIUM MINERALS by Jack DeMent and H. C. Dake, 2nd Edition, 1948. 96 pp., 22 illus. 2.00
3. MANUAL OF MINERALOGY by Edward S. Dana. 15th Edition revised by C. S. Hurlbut, Jr. 1941. 480 pp., 436 illus. 4.50
4. GETTING ACQUAINTED WITH MINERALS by George L. English. 1936. 324 pp., 258 illus. 2.75
5. TEXTBOOK OF MINERALOGY by Edward S. Dana. 4th Edition revised by William E. Ford. 1932. 851 pp., 1089 illus. 6.00
6. HISTORICAL GEOLOGY by Carl O. Dunbar. 1949. 567 pp., 380 illus. 5.00
7. OPTICAL CRYSTALLOGRAPHY by Ernest E. Wahlstrom. 1943. 260 pp., 208 illus. 3.25
8. DANA'S SYSTEM OF MINERALOGY. 7th Edition by Charles Palache, Harry Berman, and Clifford Frondel. Vol. I: Elements, Sulfides, Sulfosalts, Oxides. 1944. 834 pp., 1500 illus. 10.00
9. INDEX FOSSILS OF NORTH AMERICA by Hervey W. Shimer and Robert R. Shrock. 1944. 837 pp., 303 pls. 20.00
10. THE OCEAN by F. D. Ommaney. 1949. 238 pp., 16 illus. 2.00

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